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SOLAR/2010-79/05

Monthly Performance Report

CHARLOTTE MEDICAL CENTER

MAY 1979

FEB 14 1980

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT
CHARLOTTE MEDICAL CENTER
MAY 1979

I. SYSTEM DESCRIPTION

The Charlotte Medical Center, Charlotte, North Carolina, solar energy system was designed to provide both space heating and domestic hot water for a six-story medical library, office and classroom building. Solar energy collection is accomplished by an array of General Electric flat-plate collectors using a 50 percent (by volume) aqueous solution of ethylene glycol. The collector array has a gross area of 4,020 square feet and faces south at an angle of 35 degrees from the horizontal. Storage capacity is 6,000 gallons of water in an underground tank. In addition to the primary storage tank, there are three domestic hot water (DHW) tanks, each of which has a capacity of 125 gallons. Auxiliary heating for both subsystems is provided by electrical resistance heaters. Each DHW tank contains a 12 kw electrical immersion heater. The space heating subsystem has a capacity of 261 kw, of which 11 kw is contained in supplementary baseboard heaters on the first floor of the building.

The system, shown schematically in Figure 1, has six basic modes of operation.

Mode 1 - Collector-to-Space Heating: This mode is entered whenever there is a demand for space heating and the solar panel temperature is above 100°F. Pump P1 is started when the solar panel temperature first rises above 100°F, and will continue to run while either the solar panel temperature is above 85°F, or the water thermal storage temperature is above 85°F and the air-handling unit (AHU) is calling for heat. In this mode, pump P1 circulates the solar heated ethylene glycol solution from the collectors, through valve V2, heat exchanger HX2, valve V1, valve V4 and back to the collectors. Thus, the solar heated solution flows from the collectors directly to the space heating exchanger HX2; storage loop heat exchanger HX4 is bypassed.

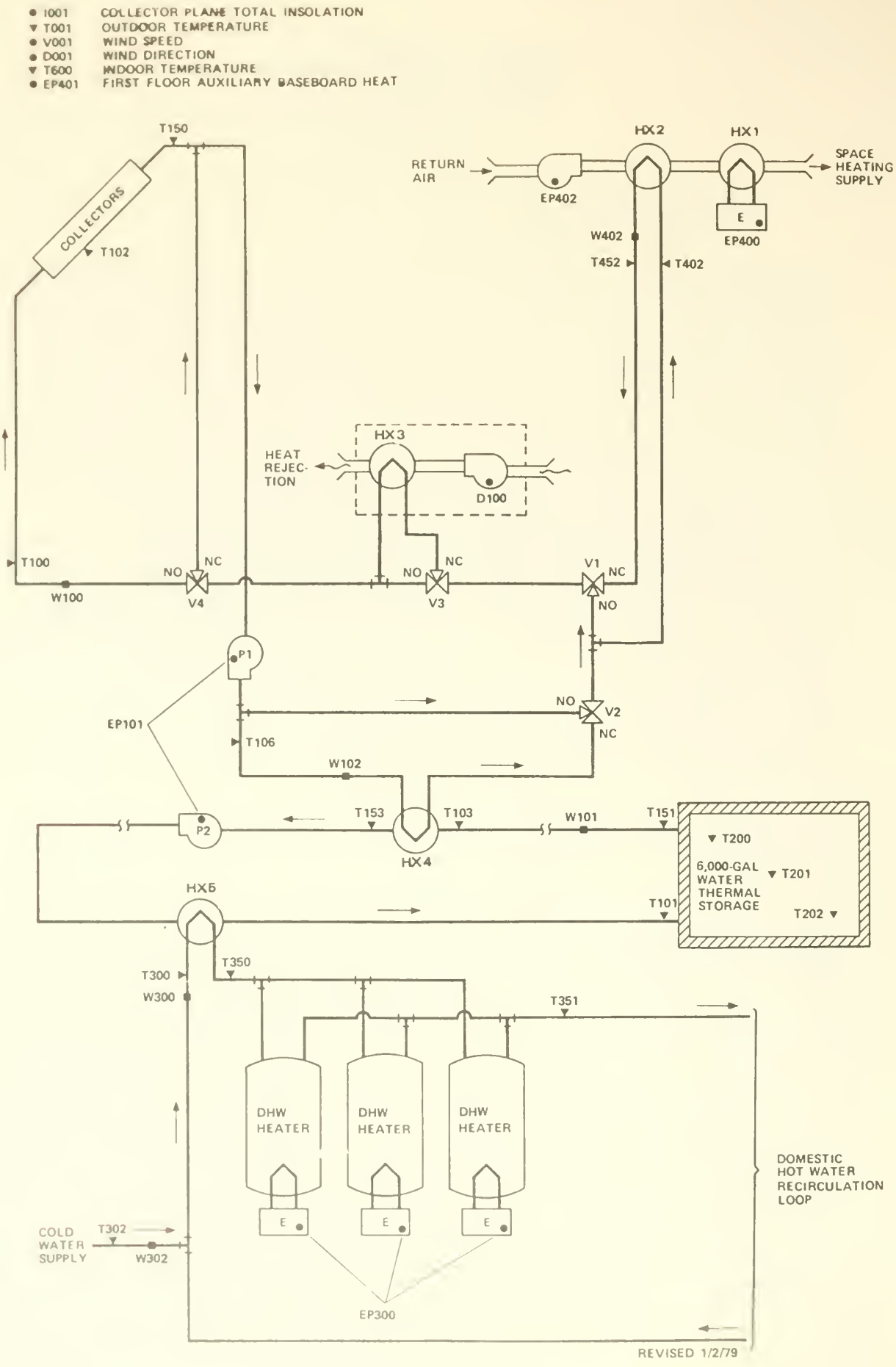

Figure 1. CHARLOTTE MEDICAL CENTER SOLAR ENERGY SYSTEM SCHEMATIC

Mode 2 - Collector-to-Space Heating and Storage: With the water thermal storage temperature below 85°F and the AHU calling for maximum heat, AHU heating valve V1 is fully open to the AHU heating coil HX2 and valve V2 is in the normally open position. As the heating demand becomes satisfied, valve V1 is modulated toward the by-pass position and valve V2 is modulated open to the storage heat exchanger HX4. When valve V2 begins to open to heat exchanger HX4, pump P2 is started, charging the 6,000-gallon water thermal storage. After the storage temperature increases above 85°F, pump P2 runs continuously to provide DHW preheat through heat exchanger HX5.

Mode 3 - Collector-to-Storage: This mode is entered when the system is running, there is no demand for space heating, and the solar panel temperature is greater than the storage temperature. During this mode, valve V2 is open to heat exchanger HX4 so that collected solar energy is delivered to storage. However, in the event that the storage temperature is greater than the solar panel temperature, valve V2 returns to the full by-pass position.

Mode 4 - Storage-to-Space Heating: This mode is entered whenever the solar panel temperature is below 85°F, the storage temperature is greater than 85°F, and there is a demand for space heating. Since the storage temperature is above 85°F, pump P2 is operating. When the AHU controls call for heating, pump P1 is started. If the solar panel temperature is below 85°F, valve V2 is positioned full open to heat exchanger HX4, and valve V4 is positioned to by-pass the solar panels. Hot water from storage is now pumped through heat exchanger HX4. Pump P1 circulates the transport fluid through the load side of heat exchanger HX4 and the AHU heating coil HX2 as determined by modulating valve V1.

Mode 5 - Excess Solar Heat Rejection: This mode is entered if the solar loop temperature increases above 200°F. Valve V2 goes to the full by-pass position and valve V3 opens to allow excess solar heat to be rejected to the atmosphere through heat exchanger HX3. Pump P2 continues to operate to preheat service hot water and valve V2 modulates to maintain a maximum temperature of 200°F in the water thermal storage.

Mode 6 - Domestic Water Preheat: This mode is entered whenever storage temperature is greater than 85°F. Pump P2 circulates water from storage through hot water heat exchanger HX5.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The operation of the Charlotte Medical Center solar energy system during May was limited to a considerable extent by improper control system behavior. There were several days during the month when the insolation level was high enough to permit solar energy collection but collector array flow was either sporadic or nonexistent. This was similar to system behavior in April but the opposite of the situation that occurred during March when collector array flow often continued into the late evening hours. These control problems have been discussed in detail in prior reports and the site contractor is addressing the problem. Although experiencing control problems, the system realized a small net hot water and space heating electrical energy savings of 1.57 million Btu for the month. A total of 5.54 million Btu of electrical operating energy was required to support the system during May.

B. Weather

During May, the measured average outside ambient temperature was 68°F. This was one degree below the long-term average ambient temperature of 69°F and had

little effect on the building heating load. Long-term temperature data are taken directly from data supplied by the National Oceanic and Atmospheric Administration's Local Climatological Data Bulletin for Charlotte.

The measured value for incident insolation in the plane of the collector array was 1,365 Btu/ft^2-day, and this was 18 percent below the long-term average of 1,674 Btu/ft^2-day. However, the measured value of insolation is in error due to a pyranometer shading problem. The pyranometer is shaded at times during the day by the instrument that monitors wind velocity and direction, so the actual value for measured insolation is apparently higher than that reported. Long-term insolation in the plane of the collector array is derived from data for Charlotte taken from the SOLMET Volume 1 - User's Manual.

C. System Thermal Performance

Collector - During May, the Charlotte solar energy system collected a net amount of 10.19 million Btu. However, approximately 0.33 million Btu were lost by the collector array due to the erratic operation caused by the control system. Also, an additional 0.43 million Btu were deliberately rejected by the heat rejection fan, and this situation was also a direct result of the sporadic collector array operation. On bright days, the fluid in the collector loop would exceed temperatures of 200°F during stagnation periods and this caused the heat rejection fan to come on for short periods of time.

A total of 170.16 million Btu of incident solar energy was measured in the plane of the collector array during May. However, as previously noted, a net amount of only 10.19 million Btu was collected. This was due to the limited amount of array operating time. As a result, the reported collector array efficiency was only six percent.

Storage - During May, a total of 12.87 million Btu was delivered to storage. Of this total, 12.83 million Btu came from the collector array, and 0.04

million Btu came from the hot water recirculation loop. The energy from the hot water recirculation loop can be traced back to the electrical auxiliary heaters in the DHW heater tanks. This is a system design problem which was discussed in detail in the November 1978 report.

It should be noted that the value tabulated for solar energy delivered to storage is greater than the value for collected solar energy. This problem is also due to the sporadic collector array flow noted previously. The data collection system uses a discrete measurement sampling scheme so, in all probability, there were numerous instances when energy was being collected in the interval between data samples, but not at the time the actual sample occurred. Since the collector array flow was off at the time of data sampling there would be no energy gain credited to the system for the complete sampling period, even though some solar energy had been collected. However, as there were no erratic flow problems in the storage loop, the solar energy collected and transferred to the storage loop would be accounted for and this resulted in the seeming disparity between collected and stored solar energy.

A total of 8.09 million Btu was removed from storage during the month. However, approximately 0.33 million Btu of this energy was rejected to the atmosphere because of the control problems.

The change in stored energy was -0.43 million Btu, and this, plus the energy supplied to and removed from storage, resulted in a thermal loss from storage of 5.21 million Btu. Storage was maintained at an average temperature of 120°F, and the monthly storage efficiency was 0.60.

Hot Water Load - The hot water load for May was 1.55 million Btu. This is based on an average supply water temperature of 74°F, an average service hot water temperature of 117°F and an average daily consumption of 130 gallons of hot water. Solar energy supplied to the hot water subsystem amounted to 6.75 million Btu. However, because of a design problem with the recirculation loop in the hot water subsystem, a total of 0.04 million Btu of electrical auxiliary energy was delivered from the service hot water tanks to the

solar energy storage loop. This resulted in a net energy delivery to the hot water subsystem of 6.71 million Btu. This design problem was discussed in detail in the November 1978 report.

The indicated hot water solar fraction of 95 percent is based only on periods when solar energy was being delivered to the hot water subsystem. During periods when auxiliary energy was being delivered to the solar energy storage loop, the hot water solar fraction was considered to be zero.

It should be noted that in spite of the design problem and erratic collector array performance, the hot water subsystem was supported almost entirely by the solar energy system in May.

Approximately 0.58 million Btu of auxiliary electrical energy were delivered to the hot water subsystem. Therefore, a total of 7.33 million Btu was actually used to support the hot water subsystem. Since the actual hot water load was 1.55 million Btu, and 0.04 million Btu were delivered back to the solar energy storage loop, the total losses for the hot water tanks and recirculation loop piping amounted to 5.74 million Btu for May.

Space Heating Load - The space heating load for May was 27.98 million Btu. Solar energy supplied 0.40 million Btu of this load, which resulted in a heating solar fraction of 2 percent. The remaining 27.52 million Btu of energy required to support the space heating subsystem were supplied by the supplemental baseboard electrical auxiliary system on the first floor of the building. The main electrical auxiliary system was turned off in early April and showed no energy consumption during May.

Although the performance of the space heating subsystem appears low for May, it must be realized that the auxiliary energy supplied to the building heating load was utilized entirely in the medical library area on the first floor. This area was not designed to receive any significant support from the solar heating subsystem even though it must be included in the total building heating load computation. Therefore, any time the main portion of the building

heating load is small (or nonexistent), the heating solar fraction will be low if any auxiliary heat is used in the library area.

The total energy delivered to the building maintained an average interior temperature of 71°F. The average outside ambient temperature was 68°F.

D. Observations

The May operation of the Charlotte Medical Center solar energy system was somewhat contrary to the system design. The abnormal operation, in conjunction with the control system and hot water subsystem design problems, degraded system performance to some extent.

E. Energy Savings

During the month of May, the Charlotte solar energy system realized a net electrical energy savings of 1.57 million Btu. The space heating subsystem and hot water subsystem operation saved a total of 7.11 million Btu, but this was reduced by the 5.54 million Btu of electrical energy required to operate the system.

III. ACTION STATUS

The system problems were previously brought to the attention of the system designer and the situation is under detailed investigation. A modification to the present control system has been proposed and submitted to the Marshall Space Flight Center for approval.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION: THE CHARLOTTE SOLAR SYSTEM PROVIDES HEATING AND HOT WATER FOR THE AREA HEALTH AND EDUCATION FACILITY. THIS FACILITY HAS 65,000 SQ. FT. CONTAINIED IN SIX STORIES AND USES ELECTRICITY FOR AUXILLARY HEATING. THE DHW SYSTEM HAS THREE(3) 12 KW HEATERS AND THE SPACE HEATING SYSTEM HAS A 250 KW STRIP HEATER ALONG WITH 11.1 KW OF SUPPLEMENTAL BASEBOARD HEAT ON THE FIRST FLOOR.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	170.164	MILLION BTU
	42329	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	10.189	MILLION BTU
	2535	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	68	DEGREES F
AVERAGE BUILDING TEMPERATURE	71	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.04	
ECSS OPERATING ENERGY	5.535	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	5.641	MILLION BTU
TOTAL ENERGY CONSUMED	43.923	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.548	27.981	N.A.	29.529 MILLION BTU
SOLAR FRACTION	95	2	N.A.	7 PERCENT
SOLAR ENERGY USED	6.711	0.400	N.A.	7.110 MILLION BTU
OPERATING ENEPGY	N.A.	0.106	N.A.	5.641 MILLION BTU
AUX. THERMAL ENERGY	0.575	27.519	N.A.	28.094 MILLION BTU
AUX. ELECTRIC FUEL	0.575	27.519	N.A.	28.094 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	6.711	0.400	N.A.	1.575 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.263

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION: THE CHARLOTTE SOLAR SYSTEM PROVIDES HEATING AND HOT WATER FOR THE AREA HEALTH AND EDUCATION FACILITY. THIS FACILITY HAS 65,000 SQ. FT. CONTAINIED IN SIX STORIES AND USES ELECTRICITY FOR AUXILLARY HEATING. THE DHW SYSTEM HAS THREE(3) 12 KW HEATERS AND THE SPACE HEATING SYSTEM HAS A 250 KW STRIP HEATER ALONG WITH 11.1 KW OF SUPPLEMENTAL BASEBOARD HEAT ON THE FIRST FLOOR.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	179.523 GIGA JOULES
	480693 KJ/SQ.M.
COLLECTED SOLAR ENERGY	10.749 GIGA JOULES
	28783 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	20 DEGREES C
AVERAGE BUILDING TEMPERATURE	22 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.04
ECSS OPERATING ENERGY	5.839 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	5.951 GIGA JOULES
TOTAL ENERGY CONSUMED	46.339 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.633	29.520	N.A.	31.153 GIGA JOULES
SOLAR FRACTION	95	2	N.A.	7 PERCENT
SOLAR ENERGY USED	7.080	0.421	N.A.	7.501 GIGA JOULES
OPERATING ENERGY	N.A.	0.112	N.A.	5.951 GIGA JOULES
AUX. THERMAL ENG	0.606	29.032	N.A.	29.639 GIGA JOULES
AUX. ELECTRIC FUEL	0.606	29.032	N.A.	29.639 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	7.080	0.421	N.A.	1.662 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.263

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978. SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	8.531	66	0.289	N	0.183	0.000	0.034
2	7.488	68	0.290	O	0.184	0.000	0.039
3	4.146	68	0.235	T	0.192	0.000	0.057
4	3.878	72	0.148		0.180	0.000	0.038
5	4.095	64	0.036	A	0.158	0.000	0.009
6	1.669	61	0.108	P	0.127	0.000	0.065
7	5.647	71	0.142	P	0.191	0.000	0.025
8	4.892	71	0.249	L	0.182	0.000	0.051
9	1.872	69	0.226	I	0.161	0.000	0.121
10	3.681	74	0.216	C	0.180	0.000	0.059
11	6.387	74	0.291	A	0.178	0.000	0.045
12	6.692	74	0.226	B	0.201	0.070	0.034
13	4.501	69	0.187	L	0.164	0.000	0.042
14	6.378	66	0.245	E	0.174	0.000	0.038
15	8.296	69	0.299		0.185	0.124	0.036
16	8.561	68	0.264		0.178	0.000	0.031
17	8.479	65	0.265		0.178	0.000	0.031
18	8.256	65	0.313		0.181	0.059	0.038
19	7.932	69	0.247		0.188	0.092	0.031
20	6.683	69	0.211		0.191	0.083	0.032
21	1.984	68	0.228		0.165	0.000	0.115
22	3.288	71	0.207		0.196	0.000	0.063
23	5.205	72	0.230		0.194	0.000	0.044
24	2.044	65	0.194		0.141	0.000	0.095
25	5.044	57	0.343		0.169	0.000	0.068
26	6.550	58	0.239		0.175	0.000	0.036
27	5.703	62	0.187		0.181	0.000	0.033
28	6.693	68	0.257		0.186	0.000	0.038
29	5.382	70	0.234		0.190	0.000	0.043
30	7.387	73	0.273		0.198	0.000	0.037
31	2.822	71	0.231		0.182	0.000	0.082
SUM	170.164	-	7.110	N.A.	5.535	0.427	-
AVG	5.489	68	0.229	N.A.	0.179	0.014	0.042
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLI 'G DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	8.531	0.842	0.369	75	0.043
2	7.488	0.368	0.234	78	0.031
3	4.146	0.000	0.000	73	0.000
4	3.878	0.000	0.000	78	0.000
5	4.095	0.000	0.007	66	0.002
6	1.669	0.000	0.000	62	0.000
7	5.647	0.859	0.412	79	0.073
8	4.892	1.006	0.319	76	0.065
9	1.872	0.000	0.000	70	0.000
10	3.681	0.220	0.287	79	0.078
11	6.387	2.578	1.331	86	0.208
12	6.692	0.244	0.237	83	0.035
13	4.501	0.000	0.000	79	0.000
14	6.378	0.485	0.259	71	0.041
15	8.296	1.098	0.973	78	0.117
16	8.561	0.325	0.075	76	0.009
17	8.479	0.694	0.506	71	0.060
18	8.256	0.504	0.357	73	0.043
19	7.932	0.839	0.924	80	0.117
20	6.683	0.099	0.252	78	0.038
21	1.984	0.000	0.000	73	0.000
22	3.288	0.000	0.000	77	0.000
23	5.205	0.713	0.793	79	0.152
24	2.044	0.000	0.021	68	0.010
25	5.044	0.117	-0.000	62	-0.000
26	6.550	1.230	0.750	64	0.115
27	5.703	0.422	0.154	73	0.027
28	6.693	0.913	0.966	76	0.144
29	5.382	0.183	0.070	77	0.013
30	7.387	0.764	0.894	80	0.121
31	2.822	0.000	0.000	78	0.000
SUM	170.164	14.503	10.189	-	-
AVG	5.489	0.468	0.329	75	0.060
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/05
REPORT PERIOD: MAY, 1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.605	0.311	0.183	129	0.816
2	0.520	0.284	-0.124	130	0.308
3	0.051	0.248	-0.426	123	-3.537
4	0.102	0.184	-0.268	116	-0.824
5	0.148	0.123	-0.144	112	-0.144
6	0.168	0.117	-0.154	109	-0.221
7	0.587	0.138	0.353	112	0.837
8	0.625	0.230	0.298	117	0.845
9	0.052	0.244	-0.387	117	-2.745
10	0.161	0.210	-0.070	112	0.872
11	1.230	0.223	0.893	122	0.908
12	0.624	0.225	-0.020	130	0.328
13	0.078	0.181	-0.436	125	-3.265
14	0.433	0.191	-0.065	120	0.292
15	1.120	0.313	0.570	126	0.788
16	0.157	0.291	-0.243	128	0.310
17	0.665	0.279	0.109	127	0.583
18	0.827	0.339	0.069	129	0.494
19	0.477	0.304	0.203	132	1.062
20	0.210	0.326	-0.371	130	-0.215
21	0.030	0.359	-0.417	122	-1.888
22	0.062	0.227	-0.268	115	-0.674
23	0.538	0.235	0.273	116	0.944
24	0.060	0.256	-0.348	114	-1.527
25	0.121	0.433	-0.368	107	0.531
26	0.833	0.419	0.329	106	0.897
27	0.322	0.200	0.065	110	0.822
28	0.880	0.257	0.502	117	0.862
29	0.333	0.293	-0.169	119	0.373
30	0.801	0.311	0.387	123	0.871
31	0.047	0.335	-0.387	122	-1.111
SUM	12.868	8.085	-0.431	-	-
AVG	0.415	0.261	-0.014	120	0.595
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: CHARLOTTE MEM. HOSP. & MED. CENT.
REPORT PERIOD: MAY,1979

SOLAR/2010-79/05

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.068	94	0.289	N	0.000	0.000	N	0.289	N	70	124	142
2	0.088	99	0.290	O	0.000	0.000	O	0.290	O	70	125	180
3	0.068	100	0.235	T	0.000	0.000	T	0.235	T	69	119	158
4	0.059	82	0.148		0.082	0.082		0.148		71	116	145
5	0.004	46	0.036	A	0.159	0.159	A	0.036	A	75	116	12
6	0.004	11	-0.023	P	0.229	0.229	P	-0.023	P	73	116	11
7	0.059	31	0.130	P	0.105	0.105	P	0.130	P	69	113	157
8	0.066	89	0.249	L	0.000	0.000	L	0.249	L	71	113	174
9	0.078	98	0.226	I	0.000	0.000	I	0.226	I	71	113	210
10	0.067	100	0.216	C	0.000	0.000	C	0.216	C	70	108	204
11	0.062	100	0.291	A	0.000	0.000	A	0.291	A	71	117	155
12	0.007	100	0.226	B	0.000	0.000	B	0.226	B	79	126	16
13	0.002	100	0.187	L	0.000	0.000	L	0.187	L	82	122	5
14	0.071	100	0.245	E	0.000	0.000	E	0.245	E	73	116	184
15	0.078	100	0.299		0.000	0.000		0.299		73	120	179
16	0.062	100	0.264		0.000	0.000		0.264		73	124	139
17	0.061	100	0.268		0.000	0.000		0.268		72	123	139
18	0.064	100	0.294		0.000	0.000		0.294		73	124	142
19	0.003	100	0.247		0.000	0.000		0.247		81	127	7
20	0.003	100	0.214		0.000	0.000		0.214		82	126	7
21	0.070	100	0.228		0.000	0.000		0.228		74	118	186
22	0.060	100	0.207		0.000	0.000		0.207		74	111	189
23	0.056	100	0.230		0.000	0.000		0.230		74	111	169
24	0.053	100	0.194		0.000	0.000		0.194		74	111	169
25	0.051	100	0.172		0.000	0.000		0.172		74	105	194
26	0.004	100	0.171		0.000	0.000		0.171		75	103	16
27	0.004	100	0.171		0.000	0.000		0.171		74	107	13
28	0.079	100	0.273		0.000	0.000		0.273		72	112	221
29	0.061	100	0.237		0.000	0.000		0.237		73	115	166
30	0.068	100	0.275		0.000	0.000		0.275		73	118	172
31	0.069	100	0.218		0.000	0.000		0.218		74	118	182
SUM	1.548	-	6.711	N.A.	0.575	0.575	N.A.	6.711	N.A.	-	-	4040
AVG	0.050	95	0.216	N.A.	0.019	0.019	N.A.	0.216	N.A.	74	117	130
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/05
REPORT PERIOD: MAY-1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR. OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.854	0	0.000	0.000	0.854	0.854	N	0.000	N	72	66
2	0.865	0	0.000	0.000	0.865	0.865	O	0.000	O	72	68
3	0.833	0	0.000	0.000	0.833	0.833	T	0.000	T	72	68
4	0.819	0	0.000	0.000	0.819	0.819		0.000		72	72
5	0.942	0	0.000	0.000	0.942	0.942	A	0.000	A	71	64
6	1.251	10	0.130	0.012	1.120	1.120	P	0.130	P	69	61
7	0.938	1	0.011	0.002	0.924	0.924	P	0.011	P	70	71
8	0.892	0	0.000	0.000	0.892	0.892	L	0.000	L	71	71
9	0.858	0	0.000	0.000	0.858	0.858	I	0.000	I	71	69
10	0.814	0	0.000	0.000	0.814	0.814	C	0.000	C	72	74
11	0.767	0	0.000	0.000	0.767	0.767	A	0.000	A	73	74
12	0.761	0	0.000	0.000	0.761	0.761	B	0.000	B	72	74
13	0.844	0	0.000	0.000	0.844	0.844	L	0.000	L	71	69
14	0.880	0	0.000	0.000	0.880	0.880	E	0.000	E	71	66
15	0.865	0	0.000	0.000	0.865	0.865		0.000		72	69
16	0.867	0	0.000	0.000	0.867	0.867		0.000		72	68
17	0.956	0	-0.003	0.002	0.956	0.956		-0.003		71	65
18	0.964	2	0.019	0.005	0.941	0.941		0.019		71	65
19	0.913	0	0.000	0.000	0.913	0.913		0.000		70	69
20	0.949	0	-0.004	0.003	0.949	0.949		-0.004		70	69
21	0.887	0	0.000	0.000	0.887	0.887		0.000		70	68
22	0.832	0	0.000	0.000	0.832	0.832		0.000		71	71
23	0.772	0	0.000	0.000	0.772	0.772		0.000		72	72
24	0.856	0	0.000	0.000	0.856	0.856		0.000		72	65
25	1.191	15	0.170	0.020	1.011	1.011		0.170		71	57
26	1.180	6	0.068	0.023	1.107	1.107		0.068		69	58
27	1.070	2	0.016	0.005	1.050	1.050		0.016		68	62
28	0.902	0	-0.016	0.013	0.902	0.902		-0.016		69	68
29	0.882	1	-0.003	0.014	0.872	0.872		-0.003		70	70
30	0.780	0	-0.002	0.002	0.780	0.780		-0.002		71	73
31	0.799	2	0.013	0.005	0.786	0.786		0.013		72	71
SUM	27.981	-	0.400	0.106	27.519	27.519	N.A.	0.400	N.A.	-	-
AVG	0.903	2	0.013	0.003	0.888	0.888	N.A.	0.013	N.A.	71	68
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	2122	N	66	75	N	27	3
2	1863	O	68	78	O	149	3
3	1031	T	68	73	T	185	5
4	965		72	78		207	5
5	1019	A	64	66	A	55	3
6	415	P	61	62	P	0	1
7	1405	P	71	79	P	142	3
8	1217	L	71	76	L	123	2
9	466	I	69	70	I	132	3
10	916	C	74	79	C	0	1
11	1589	A	74	86	A	0	2
12	1665	B	74	83	B	170	3
13	1120	L	69	79	L	185	4
14	1586	E	66	71	E	31	4
15	2064		69	78		0	2
16	2130		68	76		27	4
17	2109		65	71		36	4
18	2054		65	73		0	2
19	1973		69	80		0	2
20	1662		69	78		59	3
21	494		68	73		0	1
22	818		71	77		0	1
23	1295		72	79		181	4
24	508		65	68		200	5
25	1255		57	62		266	4
26	1629		58	64		250	4
27	1419		62	73		205	5
28	1665		68	76		213	4
29	1339		70	77		206	3
30	1838		73	80		144	3
31	702		71	78		180	4
SUM	42329	N.A.	-	-	-	-	-
AVG	1365	N.A.	68	75	N.A.	*	3
NBS ID	Q001		N113			N115	N114

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